IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Application No.:	09/245,625
Applicant(s):	Robert R. Burch, *et al.*
Filed:	February 5, 1999
Title:	CHEMICALLY ACTIVE FIBER COMPOSITIONS AS DELIVERY SYSTEM FOR CHEMOTHERPEUTIC AGENTS, ESPECIALLY FOR SUBSTANCES USEFUL IN DENTAL HYGIENE
TC/A.U.:	1615
Examiner:	Retford O. Berko
Confirmation No.:	5098
Docket No.:	BUR-020US

DECLARATION OF DR. ROBERT R. BURCH UNDER RULE 37 C.F.R. § 1.132

Commissioner for Patents
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Sir:

I, Dr. Robert R. Burch, hereby declare that:

1. I received a B.S. in Chemistry from Tulane University in 1978 and earned a Ph.D. in Chemistry from the University of California at Berkeley in 1982. I have been employed as a professional research chemist for more than 20 years having extensive experience in chemistry and polymer science. I have been recognized by a major US chemical company in 1999 for R&D Excellence. I have published over 27 articles in the field of polymer chemicals. Representative articles include: R.R. Burch, et al., *Macromolecules*, 23, 1065-1072 (1990); *Synthetic Metals*, 146, 43-6 (2004); and *Macromolecules*, 33, 5053-64 (2000). I have been a member of the American Chemical Society for more than 25 years.

2. I am the inventor or co-inventor for over 20 issued U.S. Patents primarily in the field of polymer chemistry. Representative patents include U.S. Patent No. 5,024,858 directed to metallized polymer and method; U.S. Patent No. 5,084,497 directed to preparation and articles of manufacture from isotropic and anisotropic

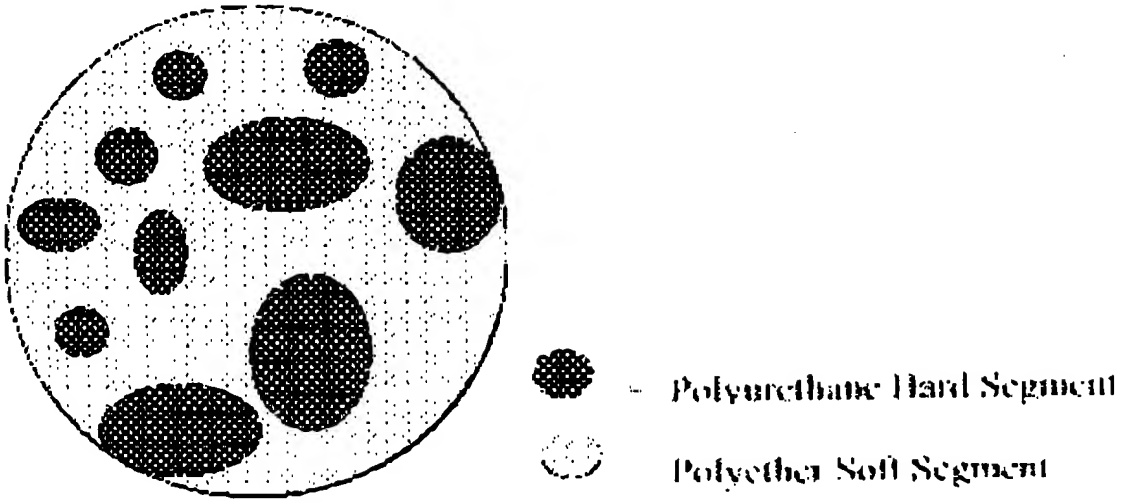
poyamide anion solutions; U.S. Patent No. 5,093,436 directed to halogenated aromatic polyamide anion; and U.S. Patent No. 5,202,389 directed to preparation of polybenzoxazoles from halogenated polyamide anions.

3. I am a co-inventor of the above-captioned Application Serial No. 09/245,625, titled Chemically Active Fiber Compositions as Delivery System for Chemotherapeutic Agents, Especially for Substances Useful in Dental Hygiene. This patent application discloses and claims an elastomeric polymer fiber imbibed with a therapeutic amount of a chemotherapeutic agent.

4. I am familiar with the extensive patent prosecution for this application, including the appeal and decision by the Board of Patent Appeals. I have also read and become familiar with U.S. Patent No. 5,098,711 to Hill et al.; 5,433,226 to Burch, and 5,499,917 to Erickson et al. I have read and understood the rejections set forth in the present Office Action dated September 9, 2004, in which claims 1, 10, 14, 19, and 30-45 stand rejected as unpatentable under 35 U.S.C. § 103(a) over Burch (U.S. 5,433,226) in view of Hill et al. (U.S. 5,098,711) in further view of Erickson et al. (U.S. 5,499,917).

5. As I have also described in detail in the specification at page 4, lines 1-12, depicted below is a schematic representation of the cross-section of an exemplary elastomeric polymer fiber, for example a spandex fiber. Chemically, an elastomeric polymer fiber consists of a "soft section" having multiple "hard segments" contained within the soft section.

6. The soft section is illustrated by the light background of the representative figure below and is discussed in the specification at page 5, lines 8-15. The soft section is a randomly arranged, amorphous polymer and has free volume spaces between its randomly arranged, polymer molecules. The soft section is most commonly a polyether and can absorb small molecules.



Schematic Drawing of the Cross Section of a Spandex Filament

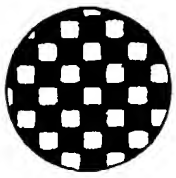
7. The hard segments described in the specification at page 5, lines 5-7 are preferably aromatic polyurea, but more typically are polyurethane, which is highly crystalline and dominated by strong hydrogen bonds between its polymer chains. The hard segments sections are typically structurally more rigid than the soft section and are impervious to small molecules. These hard segment sections are illustrated as the dark regions of representative figure below.

8. The hard segment sections are dispersed within and chemically bonded to the soft section. The hard segment sections act as a cross-linking unit or supporting structural unit holding the overall fiber together.

9. The unique structure of an elastomeric fiber having hard segment sections embedded within the soft section allows the fiber to deform by stretching and recovering to its original size.

10. The above-illustrated typical elastomeric fiber of the present invention has a structure that is vastly different from the structure of a typical fiber as

described by Hill et al. Hill et al. teaches that nylon, Teflon®, and cellulose is used to construct a multi-stranded or multi-fiber dental floss. A schematic representation of a cross-section of a typical nylon, Teflon®, or cellulose fiber is given below. Nylon is a thermoplastic polyamide resin, it has a typical denier value of between 15-18. A typical cellulose fiber is rayon having a range of single filament denier values of between 1 and 20. Teflon® is polytetrafluoroethylene (PTFE). When processed into a fiber, it has a typical denier value of 1000 or more. As I have differentiated in the Background section of the present application at page 1, lines 28-33, these fibers consist entirely of "hard segment sections" (i.e., they have no soft section), and so have very little elongation (ability to be stretched). An individual fiber of nylon, Teflon®, and cellulose is relatively impervious to absorption of small molecules.



Schematic Representation of the Cross Section of a Conventional Floss such as Nylon, Teflon, or Cellulose.

11. Another characteristic of a typical elastomeric polymer fiber, such as spandex, is that an individual fiber is generally quite large when compared to conventional fibers manufactured from nylon, Teflon®, or cellulose. A single elastomeric polymer fiber is often the diameter of a yarn of nylon, which consists of hundreds or even thousands of individual nylon fibers. As Hill et al. discloses in dental floss application, the individual nylon fibers are often bonded together by wax to form a yarn to prevent the individual fibers from splaying out. This is not necessary for a dental floss made from an elastomeric polymer fiber, e.g., a spandex fiber.

12. Because conventional dental floss is a yarn bundle of spun fibers having only a hard segment structures, as disclosed by Hill et al., the process by which these dental flosses take up amounts of chemotherapeutic agents useful in dental hygiene is to accumulate the small molecules of the agents between the individual fibers in the yarn bundle. Therefore, the more fibers in the yarn bundle, the more

inter-fiber spaces are formed, and the more of the agent these yarn bundles can accumulate. This is in contrast to an elastomeric polymer fiber of the present invention, such as spandex, which absorbs small molecules within the soft section of the fiber itself. Thus, a single elastomeric polymer fiber dental floss as claimed in the present invention can absorb large amounts of an agent useful in dental hygiene without relying on the floss being constructed from multiple fibers between which the agent is trapped or loaded.

13. The ability of a single elastomeric polymer fiber, such as spandex, to absorb large quantities of small molecules is due to its structure, particularly, to its soft section. It is useful to think of the soft section as being a polymeric liquid held together by the hard segment sections. Because the soft section chemically is an ether, it has excellent solvating power. Therefore, the driving force for absorbing small molecules is quite strong -- it is forming a solution of the small molecules in the soft section. This is quite unique to an elastomeric polymer fiber dental floss compared to any other dental floss spun from nylon, Teflon, or cellulose.

14. The absorbed or imbibed chemotherapeutic agent is released from the soft section of the elastomeric polymer fiber by diffusion gradient forces. For example, when the imbibed elastomeric fiber is dental floss and the soft section of the floss is exposed to another liquid that contains a lower concentration of the agent (such as saliva), the agent will diffuse across the concentration gradient from the soft section of the fiber into the saliva. This characteristic is a key reason why the elastomeric polymer fiber of the present invention is useful in dental hygiene, because the imbibed agent will diffuse out of the fiber and onto the patient's gums and teeth.

15. The physical properties imparted by the structure of the elastomeric polymer fiber also encourage release and absorption of a chemotherapeutic agent. For example, the act of stretching the elastomeric polymer fiber causes the amorphous polymeric molecules of the soft section to align parallel with the axis of stretching. By aligning the molecules, the free volume space that was between the amorphous molecules of the soft section is decreased. The small molecules are thereby released from the fiber. This is an extra factor in promoting release of an agent useful in dental hygiene onto the gums and teeth. Again, this is

another special characteristic of elastomeric polymer fibers compared to other, conventional dental floss materials.

16. Another important distinction of my present invention from the teachings of Hill et al. is the denier value of the fiber. Denier provides a scale for the heavyness (largely related to thickness) of fibers in a fabric or yarn. The higher the denier, the thicker the fiber.

17. To illustrate the unexpected absorption or imbibing capabilities of an elastomeric polymer fiber of the present invention, a spandex fiber was inhibited with a chemotherapeutic agent. Following the procedures described in the specification, a mixture of 3g of stannous fluoride and 15g of sodium fluoride in 300g of deionized water was heated to 95°C to dissolve the two salts. The pH of this solution was 7.5. A skein of 3.5g of spandex (280 denier) was agitated in this solution for 1 hour at 95°C. The spandex skein was then rinsed two times in 100mL of deionized water for two minutes per rinse. The spandex was then air dried to constant weight. This skein analyzed for 3060ppm of fluorine and 1275ppm of tin.

I hereby declare that all statement made herein are of my own knowledge and are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful and false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful and false statements may jeopardize the validity of the above-identified application or any patent issued thereon.

Respectfully submitted,

Dr. Robert R. Burch